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Patent No. 20350
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Attorney Docket No. 16869P-014900US

"Express Mail" Label No. EL630576362US

Date of Deposit: September 25, 2000

Assistant Commissioner for Patents
 Washington, D.C. 20231

ASSISTANT COMMISSIONER FOR PATENTS
 BOX PATENT APPLICATION
 Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 CFR 1.53(b) is the

- ☒ patent application of
☐ continuation patent application of
☐ divisional patent application of
☐ continuation-in-part patent application of

Inventor(s)/Applicant Identifier: **Ryota Mita and Akio Shinagawa**

For: **A Cellular Phone**

☐ This application claims priority from each of the following Application Nos./filing dates:

the disclosure(s) of which is (are) incorporated by reference.

☐ Please amend this application by adding the following before the first sentence: "This application is a ☐ continuation ☐ continuation-in-part of and claims the benefit of U.S. Application No. 60/_____, filed _____, the disclosure of which is incorporated by reference."

Enclosed are:

- ☒ 10 page(s) of specification
☒ 5 page(s) of claims
☒ 1 page of Abstract
☒ 7 sheet(s) of ☒ formal ☐ informal drawing(s).
☒ An assignment of the invention to Hitachi, Ltd.
☒ A ☒ signed ☐ unsigned Declaration & Power of Attorney
☒ Recordation Form Cover Sheet
☒ Preliminary Amendment

	(Col. 1)	(Col. 2)
FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	14 - 20	= *0
INDEP. CLAIMS	5 - 3	= *2
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENTED		

* If the difference in Col. 1 is less than 0, enter "0" in Col. 2.

Please charge Deposit Account No. 20-1430 as follows:

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SMALL ENTITY

RATE	FEE
	\$345.00
x \$9.00 =	
x \$39.00 =	
+ \$130.00 =	
TOTAL	

OTHER THAN SMALL ENTITY

RATE	FEE
	\$690.00
x \$18.00 =	\$
x \$78.00 =	\$156.00
+ \$260.00 =	
TOTAL	\$846.00

Respectfully submitted,
 TOWNSEND and TOWNSEND and CREW LLP

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"Express Mail" Label No. EL630576362US

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PATENT

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Assistant Commissioner for Patents

Washington, D.C. 20231

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Ryota Mita et al.

Application No.: Unassigned

Filed: Herewith

For: A Cellular Phone

Examiner: Unassigned

Art Unit: Unassigned

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents

Washington, D.C. 20231

Sir:

Prior to examination of the above-referenced application, please enter the following amendments and remarks.

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1, line 7, after the title, insert

--CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims priority from Japanese Patent Application Reference No. 11-307987, filed October 29, 1999.--

Page 1, line 11, replace "consists" with --comprises--.

Page 1, line 12, delete "Description of Related Art".

Page 1, line 32, delete "Also,".

Page 1, line 32, replace "in" with --In--.

Page 2, line 2, after “unnatural”, insert --sounding--.

Page 3, line 33, after “after”, insert --it has been--.

Page 4, line 1, after “before”, insert --it has been--.

Page 4, line 3, after “after”, insert --it has been--.

Page 4, line 20, replace “communication” with --communications, such as--.

Page 4, line 20, delete “(“.

Page 4, line 22, delete “)”.

Page 5, line 4, replace “consists” with --comprises--.

Page 5, line 11, after “93” insert --, shown in Fig. 4, --.

Page 5, line 13, replace “are” with --is--.

Page 5, line 17, replace “on” with --comprising--.

Page 5, line 28, replace “The” with --In a specific embodiment, the--.

Page 6, line 26, replace “...” with --and so forth,--.

Page 9, line 32, replace “rage” with -- range--.

Page 10, line 3, after “after” insert --it has been--.

IN THE CLAIMS:

Please amend claims 1-5 and 7-14 as follows. For the Examiner’s convenience, all pending claims are reproduced below. Those claims to which no amendment is requested appear in small print.

- 1 1. (Amended) A cellular phone comprising:
- 2 an antenna;
- 3 a high-frequency circuit unit connected to [an] the antenna;
- 4 an audio circuit unit connected to the high-frequency circuit unit;
- 5 a control means for controlling said high-frequency circuit unit and said audio
- 6 circuit unit;
- 7 a memory means connected to the control means;
- 8 a control unit connected to said control means;
- 9 a microphone and a receiver connected to said audio circuit unit;

10 a speaker for providing specified output in a range between a first frequency
11 and a second frequency; and

12 a signal generating means for supplying an audio signal to the speaker;

13 wherein signal data corresponding to an audio signal to be generated by said
14 signal generating means is stored in said memory means; and wherein **[so that]** said control
15 means controls said signal generating means based on said signal data; and

16 said signal data stored in said memory means are of **[the]** a frequency in a range
17 between said first frequency and said second frequency, and wherein the audio signal **[whose]**
18 having a frequency **[is]** in a range between said first frequency and said second frequency is
19 supplied to said speaker by said signal generating means.

1 2. (Amended) A cellular phone as claimed in claim 1,
2 wherein said signal data includes interval data, **[and]** scale data, and **[as well**
3 **as]** tone data.

1 3. (Amended) A cellular phone as claimed in claim 1,
2 wherein said memory means stores a plurality of **[pieces of]** signal data having
3 first tone data in a specified order, and stores a plurality of **[pieces of]** signal data having
4 second tone data in a specified order; and
5 **[said control means controls]** said signal generating means **[in such a manner**
6 **that]** generates an audio signal corresponding to the signal data having said first tone data and
7 an audio signal corresponding to the signal data having said second tone data **[are generated]**
8 with predetermined timing.

1 4. (Amended) A cellular phone as claimed in claim 3,
2 wherein when an audio signal corresponding to the signal data having said first
3 tone data and an audio signal corresponding to the signal data having said second tone data are
4 generated with predetermined timing, the audio signal corresponding to the signal data having
5 said first tone data and the audio signal corresponding to the signal data having said second
6 tone data form a chord relation in intervals and scales with each other **[in terms of their**
7 **intervals and scales]**.

1 5. (Amended) A cellular phone comprising:
2 an antenna;
3 a high-frequency circuit unit connected to **[an] the** antenna;
4 an audio circuit unit connected to the high-frequency circuit unit;
5 a control means for controlling said high-frequency circuit unit and said audio
6 circuit unit;
7 a memory means connected to the control means;
8 a control unit connected to said control means;
9 a microphone and a receiver connected to said audio circuit unit;
10 a speaker for providing specified output in a range between a first frequency
11 and a second frequency; and
12 a signal generating means for supplying an audio signal to the speaker;
13 wherein signal data corresponding to an audio signal to be generated by said
14 signal generating means is stored in said memory means; and wherein [so that] said control
15 means controls said signal generating means based on said signal data;
16 said signal data includes interval data, [and] scale data, and [as well as] tone
17 data; and wherein said signal data [is divided into] comprises a plurality of parts
18 corresponding to said [according to each piece of] tone data, whereby in a part having a wide
19 range of frequency distribution, said signal data includes a corresponding audio signal **[whose]**
20 having a frequency [is] in a range between said first frequency and said second frequency, and
21 is stored in said memory means; and whereby
22 in a part having a narrow range of frequency distribution, said signal data is
23 stored in said memory means when the frequency of the corresponding audio signal is in a
24 range between said first frequency and said second frequency; and
25 the audio signal stored in said memory means is supplied to said speaker.

1 6. A cellular phone as claimed in claim 5,
2 wherein said control means causes each of the audio signals of said plurality of
3 parts to be supplied to said speaker with predetermined timing.

1 7. (Amended) A cellular phone as claimed in claim 6,
2 wherein the audio signals of said plurality of parts form a chord relation in
3 intervals and scales with one another **[in terms of their intervals and scales]** when the audio
4 signals of said plurality of parts are supplied to said speaker with predetermined timing.

1 8. (Amended) A melody sound reproducing unit comprising:
2 a speaker for providing **[specified]** output in a range between a first frequency
3 and a second frequency;
4 a signal generating means for supplying an audio signal to the speaker;
5 a memory means for storing signal data corresponding to an audio signal to be
6 generated by the signal generating means; and
7 a control means for controlling said signal generating means based on said
8 signal data;
9 wherein said signal data is stored in said memory means when the frequency of
10 the corresponding audio signal is in a range between said first frequency and said second
11 frequency; and
12 the audio signal **[whose]** having a frequency **[is]** in a range between said first
13 frequency and said second frequency is supplied to said speaker.

1 9. (Amended) A melody sound reproducing unit as claimed in claim 8,
2 wherein said signal data includes interval data, **[and]** scale data, and **[as well**
3 **as]** tone data;
4 said memory means stores a plurality of **[pieces of]** signal data having first tone
5 data in a specified order and stores a plurality of **[pieces of]** signal data having second tone
6 data in a specified order; and
7 **[said control means controls]** said signal generating means **[in such a manner**
8 **that]** generates an audio signal corresponding to the signal data having said first tone data and
9 an audio signal corresponding to the signal data having said second tone data **[are generated]**
10 with predetermined timing.

1 10. (Amended) A melody sound reproducing unit as claimed in claim 9,

wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation in intervals and scales with each other [**in terms of their intervals and scales**].

11. (Amended) A melody sound reproducing method for a melody sound reproducing unit, said reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling said signal generating means based on said signal data; said method comprising:

[a step in which] storing said signal data [**is stored**] in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

[a step in which the] supplying an audio signal [**whose**] having a frequency [**is**] in a range between said first frequency and said second frequency [**is supplied**] to said speaker.

12. (Amended) A melody sound reproducing method as claimed in claim 11,

wherein said signal data includes interval data, [**and**] scale data, and [**as well as**] tone data.

13. (Amended) A melody sound reproducing [**method for a melody sound reproducing**] unit, said reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling said signal generating means based on said signal data;

7 wherein said memory means stores a plurality of **[pieces of] portions of** signal
8 data having first tone data in specified order, said signal data including a corresponding audio
9 signal **[whose] having a frequency [is]** in a range between said first frequency and said second
10 frequency, and stores a plurality of **[pieces of] portions of** signal data having second tone data
11 in specified order, said signal data including a corresponding audio signal **[whose] having a**
12 frequency **[is]** in a range between said first frequency and said second frequency; and

13 wherein said control means controls said signal generating means **[in such a**
14 **manner that]** to generate the audio signal corresponding to the signal data having said first
15 tone data and the audio signal corresponding to the signal data having said second tone data
16 **[are generated]** substantially simultaneously, whereby a sound corresponding to the signal
17 data which has said first tone data and includes a corresponding audio signal **[whose] having a**
18 frequency is in a range between said first frequency and said second frequency and a sound
19 corresponding to the signal data which has said second tone data and includes a corresponding
20 audio signal **[whose] having a** frequency is in a range between said first frequency and said
21 second frequency are produced from said speaker with a predetermined timing.

1 14. (Amended) A melody sound reproducing **[method] unit** as claimed in
2 claim 13,

3 wherein when an audio signal corresponding to the signal data having said first
4 tone data and an audio signal to the signal data having said second tone data are generated with
5 predetermined timing, the audio signal corresponding to the signal data having said first tone
6 data and the audio signal corresponding to the signal data having said second tone data form a
7 chord relation in at least one of intervals and scales with each other **[in terms of their**
8 **intervals and scales]**.

1 15. A method for reproducing a melody, said method comprising:
2 determining a range between a first frequency and a second frequency;
3 determining a frequency of an audio signal corresponding to a signal data;
4 storing said signal data in a memory in specified order when a frequency of the
5 corresponding audio signal is in said range between said first frequency and said second
6 frequency; and

supplying an audio signal having a frequency in said range between said first frequency and said second frequency as audio output.

16. A method for reproducing a melody as claimed in claim 15, further comprising:

generating with predetermined timing said audio signal, said audio signal comprising an audio signal corresponding to a first tone data of said signal data, and an audio signal corresponding to a second tone data of said signal data; and wherein, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation in intervals and scales.

17. A cellular phone comprising:

an antenna;

a high-frequency circuit unit connected to the antenna;

an audio circuit unit connected to the high-frequency circuit unit;

a controller for controlling said high-frequency circuit unit and said audio circuit unit;

a memory connected to the controller;

a control unit connected to the controller;

a microphone and a receiver connected to said audio circuit unit;

a speaker for providing specified output in a range between a first frequency and a second frequency; and

a signal generator for supplying an audio signal to the speaker;

wherein signal data corresponding to an audio signal to be generated by said signal generator is stored in said memory; and wherein said controller controls said signal generator based on said signal data; and

said signal data stored in said memory is of a frequency in a range between said first frequency and said second frequency, and wherein the audio signal having a frequency in a range between said first frequency and said second frequency is supplied to said speaker.

REMARKS

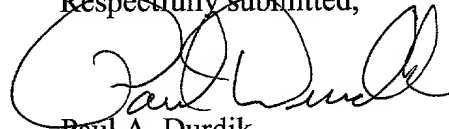
Claims 1-17 are pending in this application. Claims 1-5 and 7-14 have been voluntarily amended to more clearly set forth the claimed invention. New claims 15-17 have been added. Applicant makes minor typographical corrections to the specification. Applicant avers that no new matter has been introduced.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at .

Respectfully submitted,



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PATENT APPLICATION

A Cellular Phone

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Incorporation: Japan

Entity: Large

PATENT

Attorney Docket No. 16869P-014900

Client Ref. No. 219901005US1

5

A Cellular Phone**BACKGROUND OF THE INVENTION**

The present invention relates to a cellular phone that signals receipt of a
 10 call by using a melody, and particularly to a cellular phone suitable to generate receiving
 sound that consists of a plurality of tones.

Description of Related Art

A conventional receiving sound generator of a cellular phone supplies a
 signal corresponding to a melody stored in a memory to a speaker as it is.

15 Since smaller size and lighter weight is required of a cellular phone, a
 speaker for producing receiving sound used in the cellular phone is of small size.
 Generally, a speaker with a diameter of about 20 mm is used. In such a small-sized
 speaker, a frequency range is limited to that between a low frequency of about 400 Hz
 and a high frequency of about 8 kHz. In this frequency range, a range of about 600 Hz to
 20 about 5 kHz allows a sufficient level of sound pressure to be generated. Conventionally,
 when a signal corresponding to a receiving melody is supplied to such a speaker, the
 inputted signal is not outputted as sound in a range lower than 400 Hz or in a range higher
 than 8 kHz, and yet only electric power is consumed. On the other hand, the power
 allowed to be inputted to a speaker includes power consumed in a frequency range where
 25 a signal is not outputted as sound. Therefore, if an input signal includes a signal outside
 of a frequency range of 400 Hz to 8 kHz, the level of the input signal in the frequency
 range of 400 Hz to 8 kHz needs to be lowered in order to control the input power to
 within an allowable value. The level of the input signal needs to be controlled to a low
 level especially when a melody is to be accompanied by a chord, because the chord may
 30 include a signal for high-pitched sound or low-pitched sound that falls outside of the
 frequency range of 400 Hz to 8 kHz. Thus, it has been difficult to increase the volume of
 receiving sound. Also, in order to solve this problem, supplying an input signal through a
 bandpass filter has been considered. However, the method of supplying an input signal
 through a bandpass filter has a problem in that if a melody includes a note having a

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frequency outside of the frequency range of 400 Hz to 8 kHz, the note is omitted, thereby resulting in an unnatural melody. If a melody is accompanied by a chord and one of the chord notes falls outside of the frequency range of 400 Hz to 8 kHz, the chord is not formed, and therefore the sound may be perceived as strange when the melody is heard.

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SUMMARY OF THE INVENTION

An object of the present invention is to provide a cellular phone that makes it possible to reproduce a melody for signaling receipt of a call without impairing musical data, and to increase the volume of receiving sound.

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In order to solve the problem described above, there is provided a melody sound reproducing unit according to the present invention, comprising: a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling the signal generating means based on the signal data; wherein the signal data is stored in the memory means when the frequency of the corresponding audio signal is in a range between the first frequency and the second frequency, and the audio signal whose frequency is in a range between the first frequency and the second frequency is supplied to the speaker.

20

In addition, in order to solve the problem described above, there is provided a melody sound reproducing method for a melody sound reproducing unit according to the present invention, the reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling the signal generating means based on the signal data; wherein the signal data is stored in the memory means when the frequency of the corresponding audio signal is in a range between the first frequency and the second frequency, and the audio signal whose frequency is in a range between the first frequency and the second frequency is supplied to the speaker.

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In a preferred embodiment, the memory means stores a plurality of pieces of signal data having first tone data in specified order and stores a plurality of pieces of signal data having second tone data in specified order, and the control means controls the

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signal generating means in such a manner that an audio signal corresponding to the signal data having the first tone data and an audio signal corresponding to the signal data having the second tone data are generated simultaneously.

In another preferred embodiment, when an audio signal corresponding to the signal data having the first tone data and an audio signal corresponding to the signal data having the second tone data are generated simultaneously, the audio signal corresponding to the signal data having the first tone data and the audio signal corresponding to the signal data having the second tone data form a chord relation with each other in terms of their intervals and scales.

According to the present invention, it is possible to provide a cellular phone that makes it possible to reproduce a melody for signaling receipt of a call without impairing musical data, and to increase the volume of receiving sound.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the circuit configuration of a cellular phone according to a first embodiment of the present invention;

Fig. 2 is an exploded perspective view of the structure of a cellular phone according to a first embodiment of the present invention;

Fig. 3 is a perspective view of the circuit board of a cellular phone according to a first embodiment of the present invention;

Fig. 4 is a perspective view of the outward appearance of a cellular phone according to a first embodiment of the present invention;

Fig. 5 is a graph showing the frequency characteristics of the speaker of a cellular phone according to a first embodiment of the present invention.

Fig. 6 shows the relation between the chords and the frequencies of note data used for a cellular phone according to a first embodiment of the present invention;

Fig. 7 is a flowchart showing a frequency shift of a cellular phone according to a first embodiment of the present invention;

Fig. 8 is a flowchart showing a frequency shift of a cellular phone according to a second embodiment of the present invention; and

Figs. 9(a) and 9(b) are charts showing the frequency characteristics of the speaker of a cellular phone according to a second embodiment of the present invention as well as a frequency distribution of note data before and after stepped up, Fig. 9(a) being a

characteristic chart showing the frequency distribution of the note data before stepped up and Fig. 9(b) being a characteristic chart showing the frequency distribution of the note data after stepped up.

5 DESCRIPTION OF THE SPECIFIC EMBODIMENTS

A first embodiment of the present invention will be described with reference to Figs. 1 to 7.

As shown in Fig. 1, a cellular phone according to the first embodiment of the present invention is provided with an antenna 10, a high-frequency circuit unit 20 connected with the antenna 10, an audio circuit unit 30 connected with the high-frequency circuit unit 20, and a speaker 40, a receiver 46, and a microphone 48 (hereinafter referred to as a mike) connected with the audio circuit unit 30. The audio circuit unit 30 includes an FM sound source 35 that generates receiving sound. The cellular phone according to the first embodiment is further provided with a CPU 60 as a control means for controlling various functions. The CPU 60 controls the high-frequency circuit unit 20 and the audio circuit unit 30 according to a control program stored in a memory 80 that is connected to the CPU 60. The CPU 60 is connected with a control unit 70 and a display unit 50. The CPU 60 controls the high-frequency circuit unit 20 and the audio circuit unit 30 also according to input from the control unit 70 based on a control program, and displays on the display unit 50 information necessary for communication (the state of electric waves, the telephone number of the person at the other end of a phone call, e-mail addresses, and e-mail data to be received or transmitted, and the like) or information necessary for the user of the cellular phone.

As shown in Figs. 2 and 3, the high-frequency circuit unit 20, the audio circuit unit 30, the CPU 60, the memory 80, the control unit 70, the display unit 50, the speaker 40, the receiver 46, and the mike 48 are mounted on a circuit board 65. For the convenience of description, suppose that the side where the control unit 70 is mounted is a front side, and the opposite side is a rear side. Then the control unit 70, the display unit 50, the receiver 46, and the mike 48 are mounted on the front side of the circuit board 65, while the high-frequency circuit unit 20, the audio circuit unit 30, the CPU 60, the memory 80, and the speaker 40 are mounted on the rear side of the circuit board 65. The high-frequency circuit unit 20 is covered with a shield 20a, and the speaker 40 is placed on the surface of the shield 20a with an elastic member situated intermediate between the

speaker 40 and the surface of the shield 20a. On a side of the circuit board 65 where the mike 48 is placed, there is provided a connector 66 for connection with a charging adapter or for data communication with a personal computer (hereinafter referred to as PC) or the like. A casing 90 consists of a case 92 and a cover 94. The case 92 covers the rear side of the circuit board 65, while the cover 94 covers the front side of the circuit board 65. The antenna 10, which is capable of telescoping, is placed on a side of the case 92 where the speaker 40 is mounted, and connected to the high-frequency circuit unit 20 via a contact piece 10a provided on the rear side of the circuit board 65 in an entirely housed state or in an entirely extended state. A cover 66a that can open and close is provided on a side of the case 92 that is opposite to the antenna 10 side so as to cover an opening of the connector 66. A battery housing unit 92a for housing a rechargeable battery 93 is formed on the external surface of the rear side of the case 92.

As shown in Fig. 4, there are provided on the cover 94 the receiver 46, the display unit 50, the control unit 70, and the mike 48 along a direction from the antenna 10 side to the cover 66a side.

The cellular phone according to the first embodiment has a function of reproducing a melody on receiving a call, instead of a bell sound. Data on the melody is stored in a melody memory unit 85 in the memory 80. The melody is reproduced mainly from four types of melody data, that is, : (1) fixed melody data stored in the melody memory unit 85 when the cellular phone is manufactured; (2) melody data downloaded via the Internet after the user purchased the cellular phone, and stored in the melody memory unit 85; (3) melody data transferred via e-mail after the user purchased the cellular phone, and stored in the melody memory unit 85; and (4) melody data created by the user by using a terminal such as a PC after the user purchased the cellular phone, and stored in the melody memory unit 85.

The melody is formed by inputting note data including tone data for imitating the tone of a musical instrument, as well as data on intervals, scales, and sound length. The tone data provides 128 types of basic tones including those of a piano, a guitar, a flute, and a synthesizer. If necessary, the variety of sound expression can be increased by adding other tone data.

Fig. 5 is a graph showing the frequency characteristics of the speaker of the first embodiment. The speaker 40 is capable of outputting an input signal in the form of sound waves in a frequency range between $fc1$, the lowest frequency, and $fc2$, the

highest frequency. According to the first embodiment, f_{c1} is 400 Hz, and f_{c2} is 8 kHz. The speaker 40 has substantially flat output characteristics particularly in a frequency range of f_1 to f_2 , and the characteristic peak is set at a frequency f_Q , which is used to reproduce the bell sound of the phone. According to the first embodiment, f_1 is 600 Hz, and f_2 is 5 kHz. Also, the frequency f_Q is 2 kHz to 3 kHz, and the peak is set in such a way that a standard bell sound (ON for one second at a frequency of 2 kHz to 3 kHz and OFF for two seconds) can be produced at a high sound volume level of about 95 dB.

The range between 600 Hz to 5 kHz provides excellent conversion efficiency, and therefore provides a high level of sound pressure even with a little electric power. In the first embodiment, note data is set in such a way that a melody can be formed within a range between a first frequency f_{c1} of 400 Hz and a second frequency f_{c2} of 8 kHz. As shown in Fig. 6, of the scale chords, G#3 (415.3 Hz) exceeds the frequency of 400 Hz; however, a frequency equal to a scale chord A3 (440.0 Hz) or higher than the scale chord A3 is used in the first embodiment to prevent power consumption at the frequency f_{c1} or lower.

In order to form a melody, tone data and note data are stored in specified order in the melody memory unit 85, which serves as a memory means. In the first embodiment, a melody is reproduced with an accompanying chord. For the tone of the chord, the tone of a musical instrument different from that playing the melody is used. In this case, tone data (first tone data) corresponding to the musical instrument that plays the melody and note data to be played with the tone data are stored in specified order in the melody memory unit 85. Also, tone data (second tone data) corresponding to the musical instrument that plays the chord notes and note data to be played with the tone data are stored in specified order in the melody memory unit 85. Depending on the musical number, a plurality of pieces of note data to be played with third tone data, a plurality of pieces of note data to be played with fourth tone data, ... are also stored in specified order in the melody memory unit 85. The CPU 60 serving as a control means controls the FM sound source 35 in such a manner that the FM sound source 35 serving as a signal generating means generates an audio signal corresponding to the melody and an audio signal corresponding to the chord notes with predetermined timing. The timing is set in such a manner as to make the person hearing the melody perceive the chord. More specifically, the timing is set in such a manner as to make the audio signals simultaneous,

or make a time difference between the audio signals controlled to such a degree that the audio signals are perceived as simultaneous.

A sound imitating an acoustic bass and other musical instruments that produce low-pitched sound, for example, is used in some cases as the tone of the chord.

5 In this case, the scale frequency of the inputted note data can be lower than $fc1$, depending on the melody. In a case where fixed melody data is stored in the melody memory unit 85 when the cellular phone is manufactured, or in a case where melody data is created by the user by using a terminal such as a PC after the user purchased the cellular phone, and stored in the melody memory unit 85, a melody is formed by selecting
10 in advance a chord whose frequency is 400 Hz or more even in a low range as note data to be stored. In a case where melody data is downloaded via the Internet after the user purchased the cellular phone, and stored in the melody memory unit 85, or in a case where melody data is transferred via e-mail after the user purchased the cellular phone, and stored in the melody memory unit 85, scale correction software is stored in the
15 memory 80 so that the CPU 60 shifts the scale of the note data and thereby makes the frequency become 400 Hz or more, as shown in Fig. 7. Specifically, the CPU 60 reads note data (S101) to determine whether the note data includes a note whose scale is lower than A3 (S102). If the answer is Yes, the CPU 60 steps up the whole note data to be reproduced with the tone of the selected musical instrument by a half step (frequency shift) (S103), and determines again whether the note data includes a note whose scale is
20 lower than A3 at the step S102. If the answer is Yes, the CPU 60 repeats the steps S103 and S102 of stepping up the note data by a half step and determining again whether the note data includes a note whose scale is lower than A3. If the answer is No, the CPU 60 proceeds to setting operation (S104). The set note data is stored in a predetermined area
25 in the melody memory unit 85. Thus, all of the note data to be reproduced falls within a range of 400 Hz to 8 kHz. Therefore, electric power consumed by the speaker 40 is not wasted, and the level of the input signal can be increased within a range of allowable input power values of the speaker 40. It is not necessary to lower the level of the input signal even when the melody is to be reproduced with a chord because the inputted note
30 data falls within a frequency range of 400 Hz to 8 kHz.

According to the first embodiment, especially in the case of a melody with a few low-pitched parts, most of the note data falls within a frequency range of 600 Hz to 5 kHz even when the melody is accompanied by a chord. Therefore, the electric power of

the input signal can be efficiently converted into sound energy, thereby making it possible to reproduce the melody at a high sound volume level. In addition, even when the low-pitched parts are accompanied by a chord, the note data falls within a frequency range of 400 Hz to 8 kHz. Therefore, all of the chord notes can be reproduced, thereby producing agreeable, natural sound and allowing the user to hear high-quality receiving sound.

A second embodiment of the present invention will be described with reference to Figs. 8 and 9. In the second embodiment, provided note data includes a plurality of musical parts. Therefore, as shown in Fig. 8, a part is first selected (S201), and then note data included in the selected part is read (S202) in order to perform energy analysis, that is, analyze frequency components of the note data (S203). Then, whether the note data is to be stepped up or not is determined, depending on the result of the analysis. In the second embodiment, the distribution of frequency components of the note data is analyzed after the note data is read, as shown in Fig. 8. For example, analysis is performed by determining the distribution of notes at each scale. As shown in Fig. 5, the speaker 40 is capable of outputting an input signal in the form of sound waves in a frequency range between $fc1$, the lowest frequency, and $fc2$, the highest frequency, where $fc1$ is 400 Hz, and $fc2$ is 8 kHz, for example. Based on the result of the analysis of frequency components, the proportion of the whole note data occupied by notes having a frequency $fc1$ or lower is calculated to determine whether the proportion is more than 60% (S204). If the proportion of the whole note data occupied by notes having a frequency $fc1$ or lower exceeds 60%, most of the sound will not be reproduced. Therefore, the note data is stepped up when the proportion of the note data occupied by notes having a frequency $fc1$ or lower is more than 60% (S205). As in the case of the first embodiment, the whole note data included in the selected part is stepped up by a half step, and the steps S205 and S204 are repeated until the proportion of the note data occupied by notes having a frequency $fc1$ or lower becomes less than 60%. If the proportion of the note data occupied by notes having a frequency $fc1$ or lower becomes less than 60%, scale setting operation is performed (S206). Then whether there is another part or not is determined (S207). If there is another part, the processing returns to the step S201. If there is no other part, the processing ends (S208). Accompanying parts in a low range often fall outside of the low range that can be reproduced by the speaker especially when the melody signaling receipt of a call includes a chord. This tendency becomes more obvious as the number of accompanying parts is increased. In the second

embodiment, when there are a large number of accompanying parts, distribution of frequency components of note data is analyzed for each of the parts, and whether the note data is to be stepped up or not is determined for each of the parts. For example, if there are three accompanying parts other than the melody part, and one of the three parts in a low range, such as an acoustic bass, falls outside of the low range of the speaker, as shown in Fig. 9(a), only that part is stepped up until it reaches a state shown in Fig. 9(b) so that all of the parts exist within the range that can be reproduced by the speaker. An audio signal for each of the parts is controlled by the control means in such a way that the audio signal is reproduced with predetermined timing. The timing is set in such a manner as to make the person hearing the melody perceive the chord. More specifically, the timing is set in such a manner as to make the audio signals simultaneous, or make a time difference between the audio signals controlled to such a degree that the audio signals are perceived as simultaneous. This makes it possible for the user of the cellular phone to enjoy a melody with a chord. It is to be noted that if distribution of frequency components of note data falls way outside of the low range of the speaker, the note data may be stepped up not by a half step but by a whole step or more.

The possibility that an accompanying part in a low range includes sound at a frequency of 400 Hz or lower at a rate of more than 60% is increased especially when a melody has three accompanying parts, which is called a four-chorded melody, or a melody has more than three accompanying parts. In this case, the resulting sound may be monotonous if all of the parts are stepped up to more than 400 Hz. In such a case, a melody can be reproduced in a wide range by using a speaker capable of reproducing a wider frequency range or, for example, a speaker capable of reproducing a low range down to 200 Hz, and determining for each part whether the note data is to be stepped up or not by using 200 Hz as a criterion for judgment. Specifically, it is possible to reproduce sound down to a scale chord A2, and therefore it is possible to widen the reproducible range by one octave as compared with the case where 400 Hz is used as a criterion.

This makes it possible to reproduce most of the sound of accompanying parts such as an acoustic bass, whose sound is distributed in a low range at a rate of 70% to 80%, by stepping up the note data. As for an accompanying part played by a musical instrument producing a wide range of sound, the proportion of the note distribution of the accompanying part that falls outside of the low range of the speaker is small, and

therefore the note data is not stepped up. Thus, it is possible to prevent the sound of the accompanying part on the high range side from falling outside of the reproducible range of the speaker after stepped up. Therefore, in the second embodiment, most of the sound of each part can be contained within the reproducible range of the speaker even when the

5 number of chord notes is increased.

The preceding has been a description of the preferred embodiment of the invention. It will be appreciated that deviations and modifications can be made without departing from the scope of the invention, which is defined by the appended claims.

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What is claimed is:

- 1 1. A cellular phone comprising:
 - 2 a high-frequency circuit unit connected to an antenna;
 - 3 an audio circuit unit connected to the high-frequency circuit unit;
 - 4 a control means for controlling said high-frequency circuit unit and
 - 5 said audio circuit unit;
 - 6 a memory means connected to the control means;
 - 7 a control unit connected to said control means;
 - 8 a microphone and a receiver connected to said audio circuit unit;
 - 9 a speaker for providing specified output in a range between a first
 - 10 frequency and a second frequency; and
 - 11 a signal generating means for supplying an audio signal to the
 - 12 speaker;
 - 13 wherein signal data corresponding to an audio signal to be
 - 14 generated by said signal generating means is stored in said memory means so that said
 - 15 control means controls said signal generating means based on said signal data; and
 - 16 said signal data stored in said memory means are of the frequency
 - 17 in a range between said first frequency and said second frequency, and the audio signal
 - 18 whose frequency is in a range between said first frequency and said second frequency is
 - 19 supplied to said speaker.
- 1 2. A cellular phone as claimed in claim 1,
- 2 wherein said signal data includes interval and scale data as well as
- 3 tone data.
- 1 3. A cellular phone as claimed in claim 1,
- 2 wherein said memory means stores a plurality of pieces of signal
- 3 data having first tone data in specified order and stores a plurality of pieces of signal data
- 4 having second tone data in specified order; and
- 5 said control means controls said signal generating means in such a
- 6 manner that an audio signal corresponding to the signal data having said first tone data
- 7 and an audio signal corresponding to the signal data having said second tone data are
- 8 generated with predetermined timing.

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1 4. A cellular phone as claimed in claim 3,
2 wherein when an audio signal corresponding to the signal data
3 having said first tone data and an audio signal corresponding to the signal data having
4 said second tone data are generated with predetermined timing, the audio signal
5 corresponding to the signal data having said first tone data and the audio signal
6 corresponding to the signal data having said second tone data form a chord relation with
7 each other in terms of their intervals and scales.

1 5. A cellular phone comprising:
2 a high-frequency circuit unit connected to an antenna;
3 an audio circuit unit connected to the high-frequency circuit unit;
4 a control means for controlling said high-frequency circuit unit and
5 said audio circuit unit;
6 a memory means connected to the control means;
7 a control unit connected to said control means;
8 a microphone and a receiver connected to said audio circuit unit;
9 a speaker for providing specified output in a range between a first
10 frequency and a second frequency; and
11 a signal generating means for supplying an audio signal to the
12 speaker;

13 wherein signal data corresponding to an audio signal to be
14 generated by said signal generating means is stored in said memory means so that said
15 control means controls said signal generating means based on said signal data;
16 said signal data includes interval and scale data as well as tone data
17 and is divided into a plurality of parts according to each piece of tone data, whereby in a
18 part having a wide range of frequency distribution, said signal data includes a
19 corresponding audio signal whose frequency is in a range between said first frequency
20 and said second frequency, and is stored in said memory means;

21 in a part having a narrow range of frequency distribution, said
22 signal data is stored in said memory means when the frequency of the corresponding
23 audio signal is in a range between said first frequency and said second frequency; and
24 the audio signal stored in said memory means is supplied to said
25 speaker.

1 6. A cellular phone as claimed in claim 5,
2 wherein said control means causes each of the audio signals of said
3 plurality of parts to be supplied to said speaker with predetermined timing.

1 7. A cellular phone as claimed in claim 6,
2 wherein the audio signals of said plurality of parts form a chord
3 relation with one another in terms of their intervals and scales when the audio signals of
4 said plurality of parts are supplied to said speaker with predetermined timing.

1 8. A melody sound reproducing unit comprising:
2 a speaker for providing specified output in a range between a first
3 frequency and a second frequency;
4 a signal generating means for supplying an audio signal to the
5 speaker;
6 a memory means for storing signal data corresponding to an audio
7 signal to be generated by the signal generating means; and
8 a control means for controlling said signal generating means based
9 on said signal data;
10 wherein said signal data is stored in said memory means when the
11 frequency of the corresponding audio signal is in a range between said first frequency and
12 said second frequency; and
13 the audio signal whose frequency is in a range between said first
14 frequency and said second frequency is supplied to said speaker.

1 9. A melody sound reproducing unit as claimed in claim 8,
2 wherein said signal data includes interval and scale data as well as
3 tone data;
4 said memory means stores a plurality of pieces of signal data
5 having first tone data in specified order and stores a plurality of pieces of signal data
6 having second tone data in specified order; and
7 said control means controls said signal generating means in such a
8 manner that an audio signal corresponding to the signal data having said first tone data
9 and an audio signal corresponding to the signal data having said second tone data are
10 generated with predetermined timing.

1 10. A melody sound reproducing unit as claimed in claim 9,
2 wherein when an audio signal corresponding to the signal data
3 having said first tone data and an audio signal corresponding to the signal data having
4 said second tone data are generated with predetermined timing, the audio signal
5 corresponding to the signal data having said first tone data and the audio signal
6 corresponding to the signal data having said second tone data form a chord relation with
7 each other in terms of their intervals and scales.

1 11. A melody sound reproducing method for a melody sound
2 reproducing unit, said reproducing unit including a speaker for providing specified output
3 in a range between a first frequency and a second frequency; a signal generating means
4 for supplying an audio signal to the speaker; a memory means for storing signal data
5 corresponding to an audio signal to be generated by the signal generating means; and a
6 control means for controlling said signal generating means based on said signal data; said
7 method comprising:
8 a step in which said signal data is stored in said memory means
9 when the frequency of the corresponding audio signal is in a range between said first
10 frequency and said second frequency; and
11 a step in which the audio signal whose frequency is in a range
12 between said first frequency and said second frequency is supplied to said speaker.

1 12. A melody sound reproducing method as claimed in claim 11,
2 wherein said signal data includes interval and scale data as well as
3 tone data.

1 13. A melody sound reproducing method for a melody sound
2 reproducing unit, said reproducing unit including a speaker for providing specified output
3 in a range between a first frequency and a second frequency; a signal generating means
4 for supplying an audio signal to the speaker; a memory means for storing signal data
5 corresponding to an audio signal to be generated by the signal generating means; and a
6 control means for controlling said signal generating means based on said signal data;
7 wherein said memory means stores a plurality of pieces of signal
8 data having first tone data in specified order, said signal data including a corresponding
9 audio signal whose frequency is in a range between said first frequency and said second

10 frequency, and stores a plurality of pieces of signal data having second tone data in
 11 specified order, said signal data including a corresponding audio signal whose frequency
 12 is in a range between said first frequency and said second frequency; and

13 said control means controls said signal generating means in such a
 14 manner that the audio signal corresponding to the signal data having said first tone data
 15 and the audio signal corresponding to the signal data having said second tone data are
 16 generated simultaneously, whereby a sound corresponding to the signal data which has
 17 said first tone data and includes a corresponding audio signal whose frequency is in a
 18 range between said first frequency and said second frequency and a sound corresponding
 19 to the signal data which has said second tone data and includes a corresponding audio
 20 signal whose frequency is in a range between said first frequency and said second
 21 frequency are produced from said speaker with predetermined timing.

1 14. A melody sound reproducing method as claimed in claim 13,
 2 wherein when an audio signal corresponding to the signal data
 3 having said first tone data and an audio signal to the signal data having said second tone
 4 data are generated with predetermined timing, the audio signal corresponding to the
 5 signal data having said first tone data and the audio signal corresponding to the signal
 6 data having said second tone data form a chord relation with each other in terms of their
 7 intervals and scales.

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A Cellular Phone

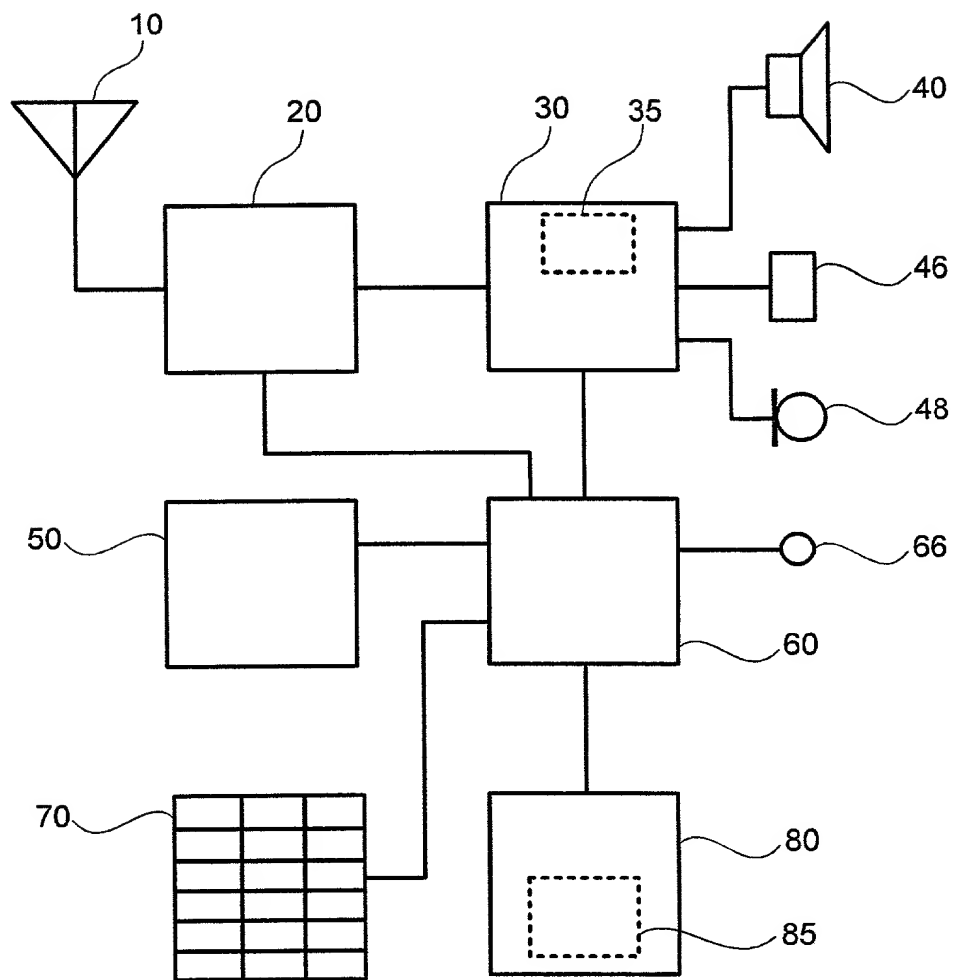
ABSTRACT OF THE DISCLOSURE

5 The present invention provides a cellular phone that makes it possible to reproduce a melody for signaling receipt of a call without impairing musical data, and to increase the volume of receiving sound.

 A cellular phone according to the present invention is provided with a melody sound reproducing unit comprising: a speaker for providing specified output in a
10 range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling the signal generating means based on the signal data, wherein the signal data is stored in the memory means when the frequency of the
15 corresponding audio signal is in a range between the first frequency and the second frequency, and the audio signal whose frequency is in a range between the first frequency and the second frequency is supplied to the speaker.

20

FIG.1



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FIG.2

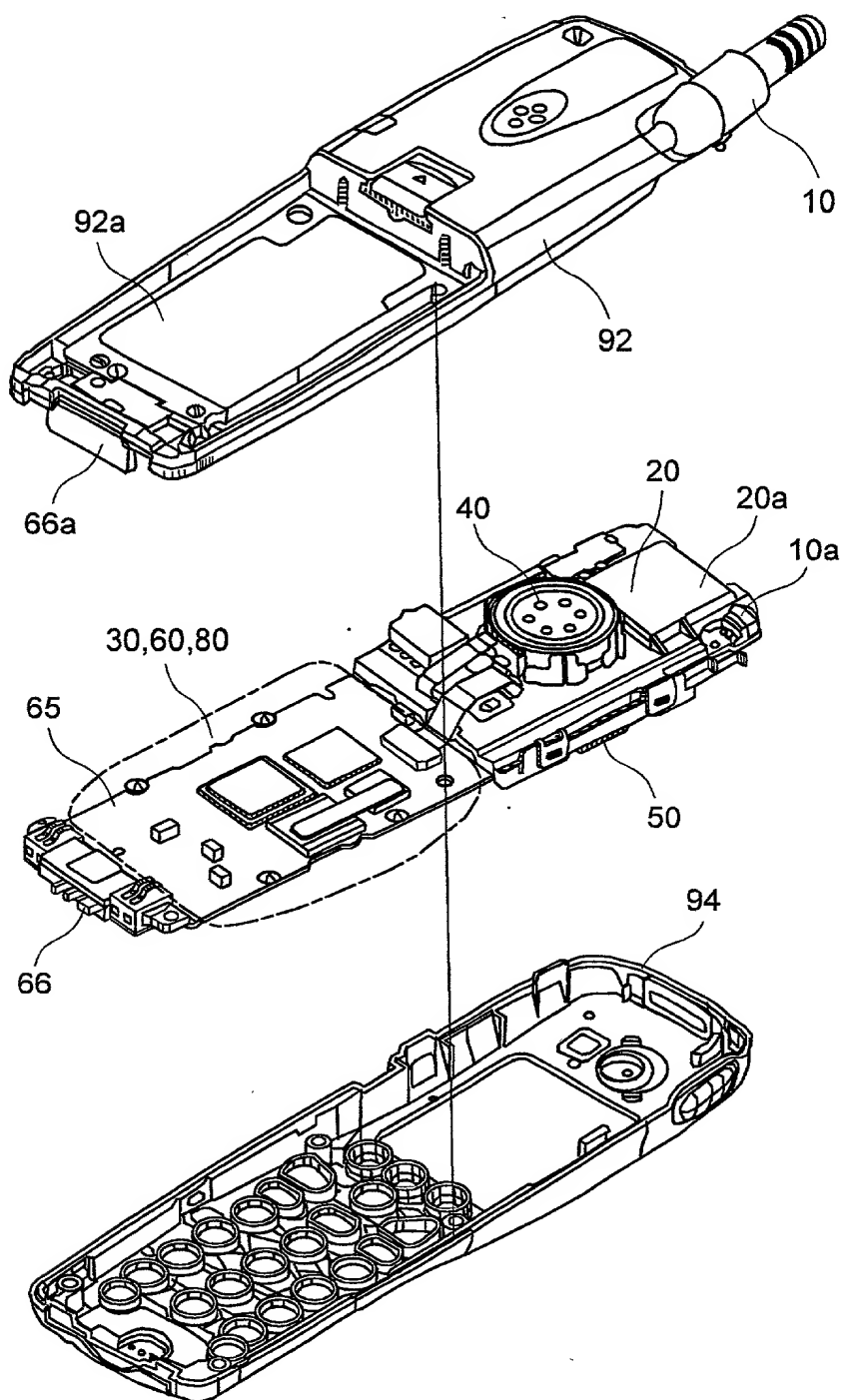


FIG.3

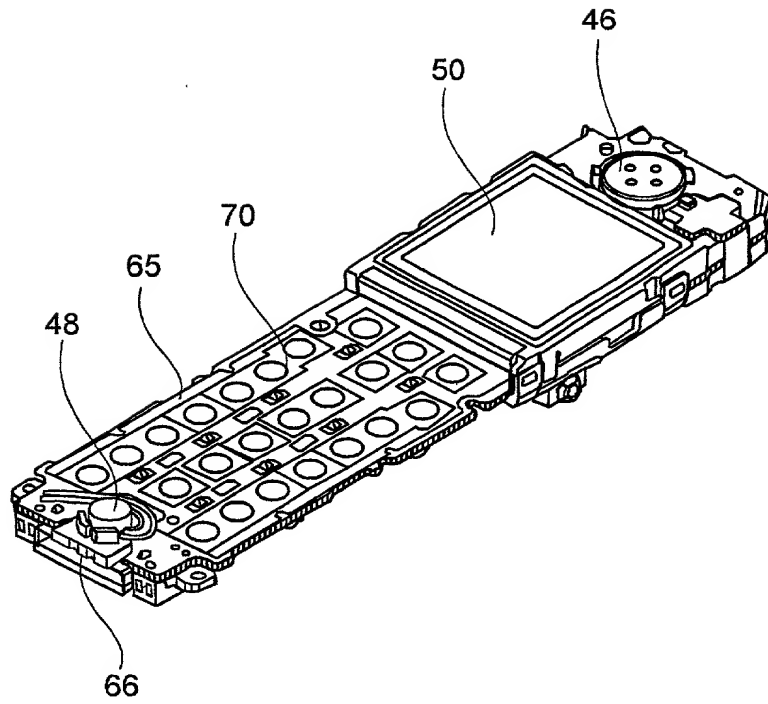


FIG.4

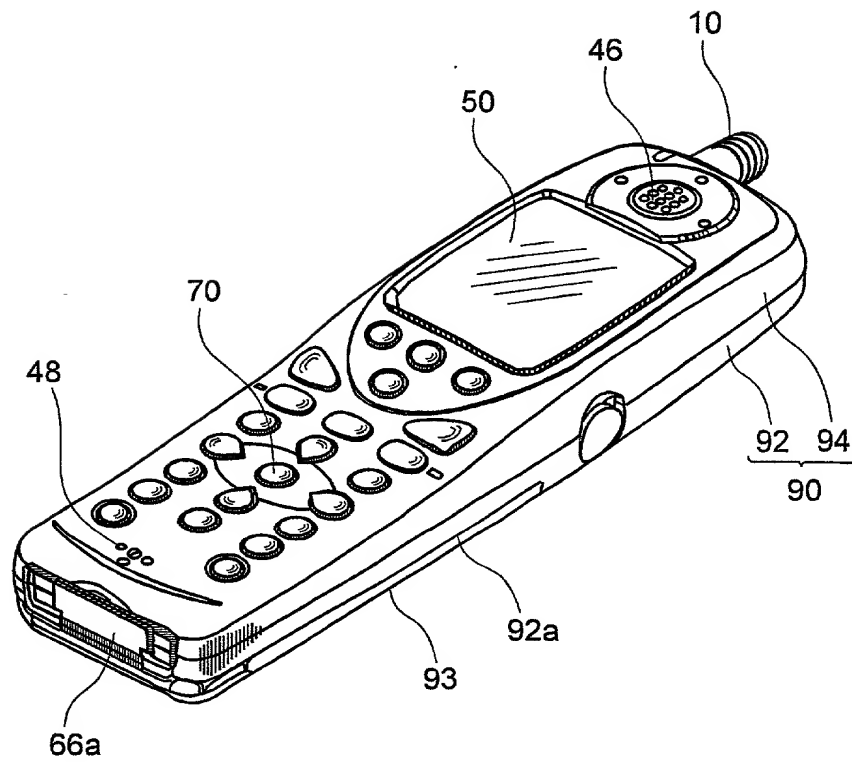


FIG.5

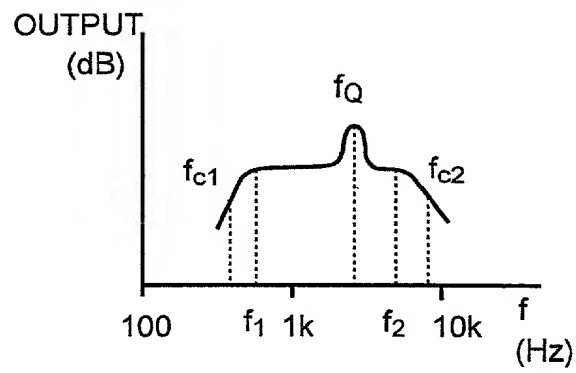


FIG.6

SCALE	FREQUENCY (HZ)	SCALE	FREQUENCY (HZ)	SCALE	FREQUENCY (HZ)
C#2	138.6	C#3	277.2	C#4	554.4
D2	146.8	D3	293.7	D4	587.3
D#2	155.6	D#3	311.1	D#4	622.3
E2	164.8	E3	329.6	E4	659.3
F2	174.6	F3	349.2	F4	698.5
F#2	185.0	F#3	370.0	F#4	740.0
G2	196.0	G3	392.0	G4	784.0
G#2	207.7	G#3	415.3	G#4	830.6
A2	220.0	A3	440.0	A4	880.0
A#2	233.1	A#3	466.2	A#4	932.3
B2	247.0	B3	493.3	B4	987.8
C3	261.6	C4	523.3	C5	1047

FIG.7

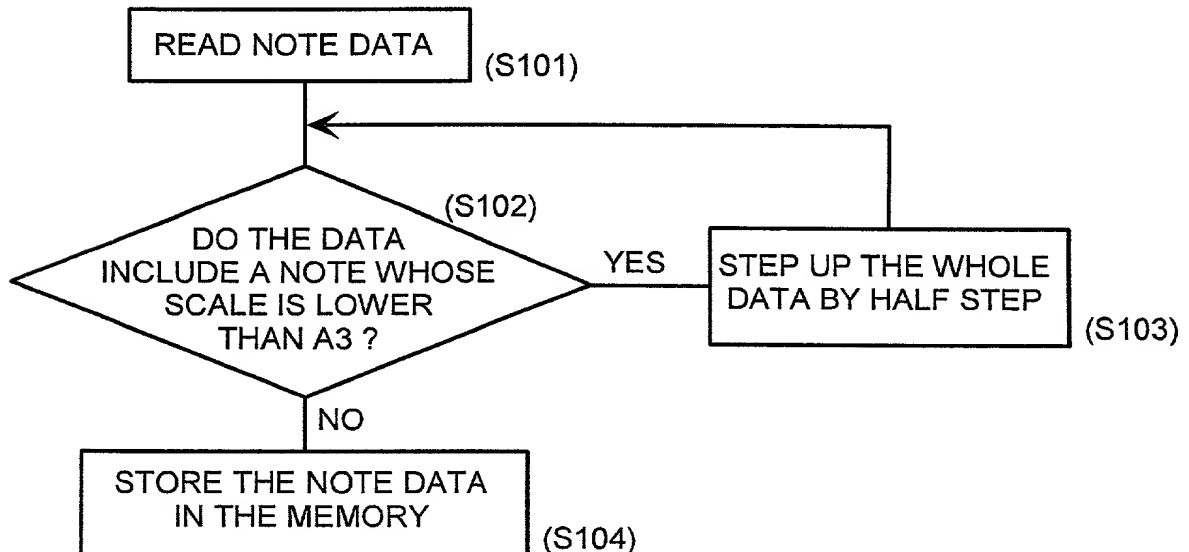


FIG.8

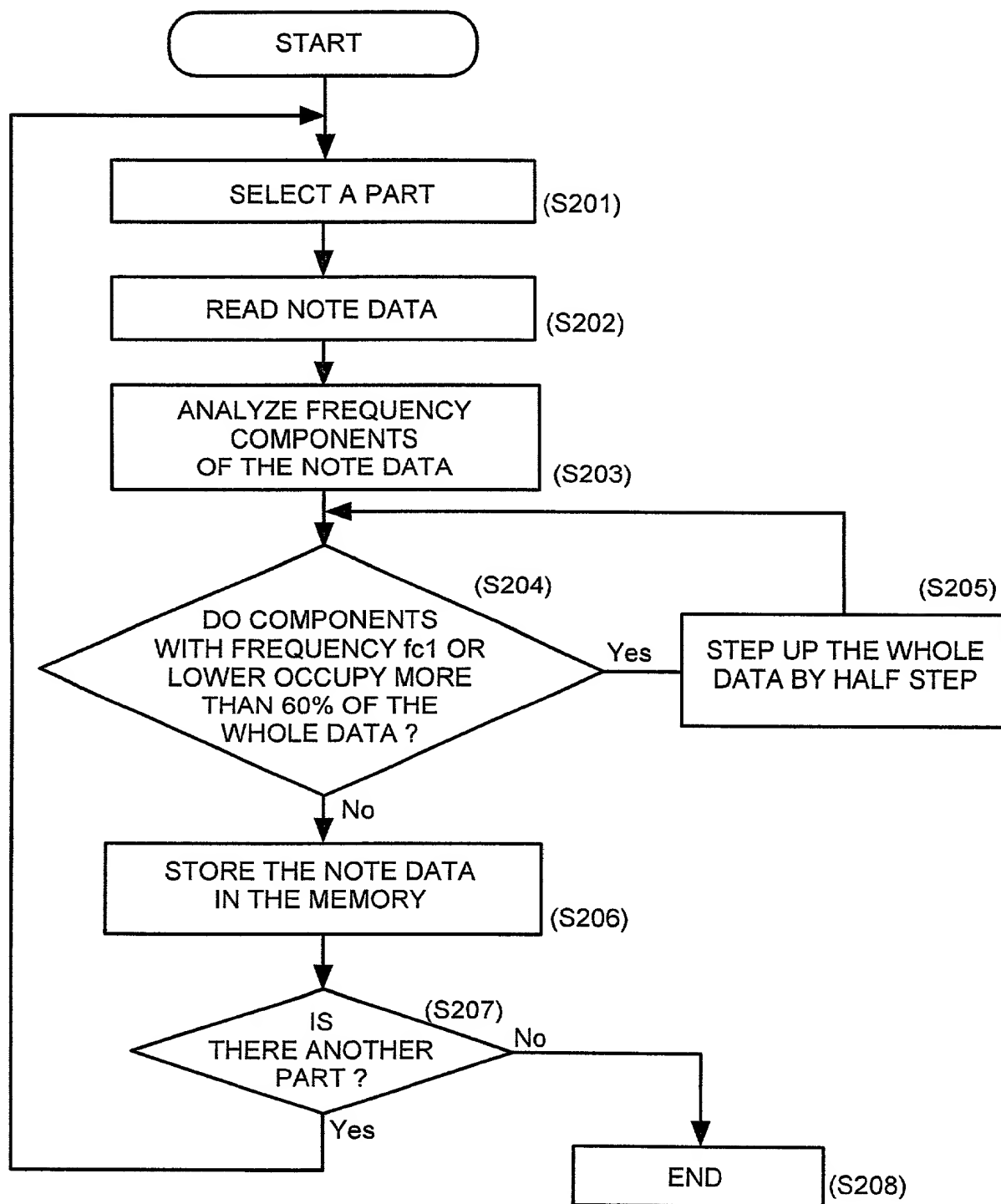
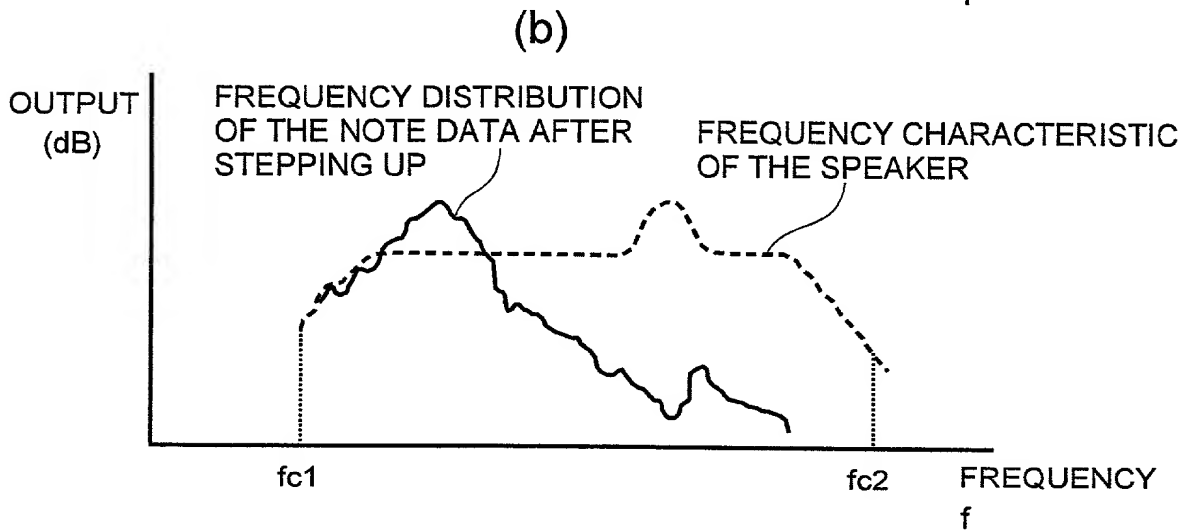
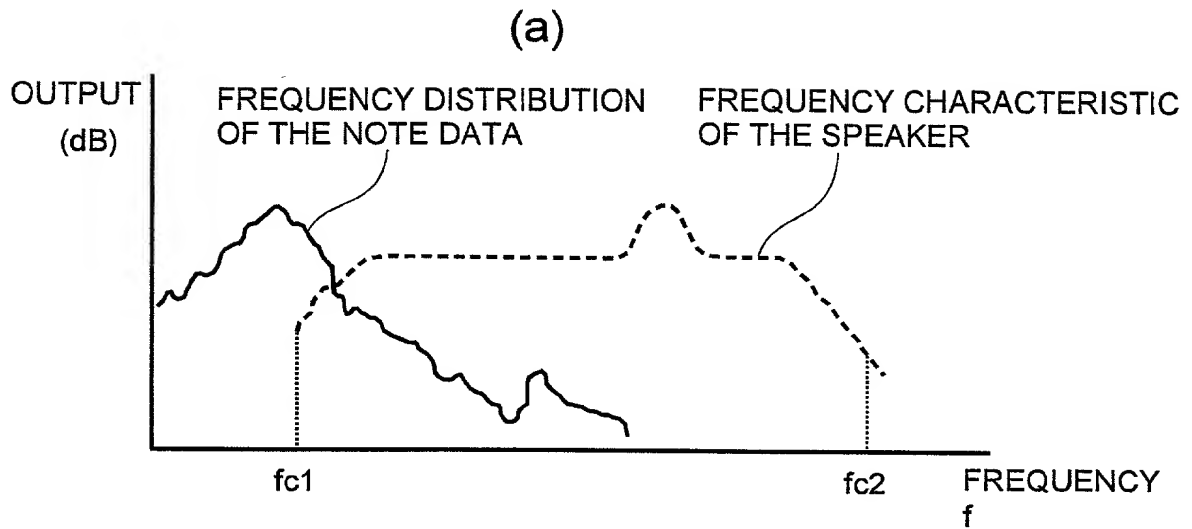


FIG.9



Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A CELLULAR PHONE

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

The specification of which is attached hereto unless the following box is checked:

☐ __月__日に提出され、米国出願番号または特許協定条約国際出願番号を____とし、
(該当する場合) _____に訂正されました。

☐ was filed on
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration (日本語宣言書)

私は、米国法典第35編119条 (a) - (d) 項又は365条 (b) 項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約365 (a) 項に基づき国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示している。

Prior Foreign Application(s)

外国での先行出願

11-307987	Japan
(Number)	(Country)
(番号)	(国名)
(Number)	(Country)
(番号)	(国名)

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(Application No.)	(Filing Date)
(出願番号)	(出願日)

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(Application No.)	(Filing Date)
(出願番号)	(出願日)

(Application No.)	(Filing Date)
(出願番号)	(出願日)

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I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

優先権主張なし

29/October/1999	
(Day/Month/Year Filed)	<input type="checkbox"/>
(出願年月日)	
(Day/Month/Year Filed)	<input type="checkbox"/>
(出願年月日)	

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.)	(Filing Date)
(出願番号)	(出願日)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of application.

(Status: Patented, Pending, Abandoned)
(現況: 特許許可済、係属中、放棄済)

(Status: Patented, Pending, Abandoned)
(現況: 特許許可済、係属中、放棄済)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration (日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。(弁護士、または代理人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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国籍	Citizenship Japan	
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(第二以降の共同発明者についても同様に記載し、署名をすること)

(Supply similar information and signature for second and subsequent joint inventors.)

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第二共同発明者		Full name of second joint inventor, if any Akio SHINAGAWA	
第二共同発明者の署名	日付	Second inventor's signature	Date
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第三共同発明者		Full name of third joint inventor, if any	
第三共同発明者の署名	日付	Third inventor's signature	Date
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第四共同発明者		Full name of fourth joint inventor, if any	
第四共同発明者の署名	日付	Fourth inventor's signature	Date
住所		Residence	
国籍		Citizenship	
私書箱		Post Office Address	
第五共同発明者		Full name of fifth joint inventor, if any	
第五共同発明者の署名	日付	Fifth inventor's signature	Date
住所		Residence	
国籍		Citizenship	
私書箱		Post Office Address	

(第六以降の共同発明者についても同様に記載し、署名をすること)
(Supply similar information and signature for sixth and subsequent joint inventors.)